California Environmental Protection Agency

Air Resources Board

DRAFT SOURCE TEST PLAN

Total and Hexavalent Chromium Emissions From the Decorative Chromium Plating Tank at Sherm's Custom Plating

MONITORING AND LABORATORY DIVISION
STATIONARY SOURCE TESTING BRANCH

&

STATIONARY SOURCE DIVISION
AIR QUALITY MEASURES BRANCH

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California Environmental Protection Agency
AIR RESOURCES BOARD
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Revised Air Resources Board Method 425 - Total Chromium and Hexavalent Chromium Emissions from Stationary Sources

Test protocol prepared by Don Ridgley

Total and Hexavalent Chromium Emissions From The Decorative Chromium Plating Tank at Sherm's Custom Plating

I. INTRODUCTION

The Air Resources Board (ARB) Monitoring and Laboratory Division (MLD) staff has been requested by the ARB Stationary Source Division to perform emissions testing for total and hexavalent chromium at unventilated decorative chromium plating facilities in California. Testing an unventilated facility will be accomplished by placing a temporary hood on top of the plating tank to perform the source test. Indoor air samples will be taken and other operating parameters recorded in conjunction with the source test. The emissions data are to be used to support ARB's Airborne Toxic Control Measure (ATCM) for Chromium Plating and Chromic Acid Anodizing facilities.

ARB staff, with the assistance of the local air pollution control district and the electroplating industry, conducted site visits to help select facilities for the testing program. During site visits, they evaluated facilities based on accessibility for source testing, facility processes, parts/objects plated, facility production, housekeeping and other requirements necessary for source testing. Staff visited Sherm's Custom Plating in April 2002 and this facility has been selected for testing.

This document outlines a site-specific source test protocol and modifications to this protocol may be necessary to accommodate unique features or conditions of this facility.

II. FACILITY DESCRIPTION

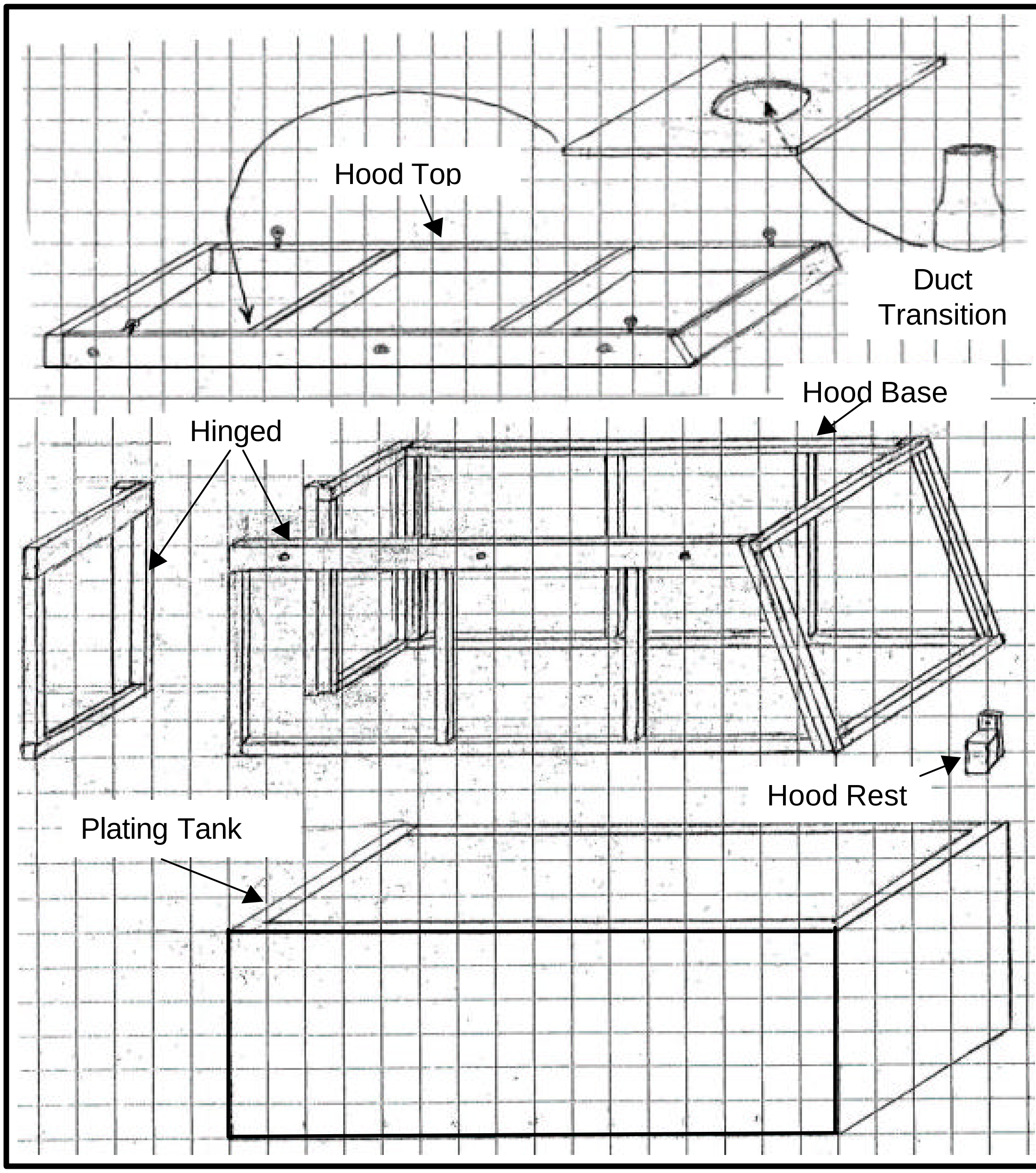
Sherm's Custom Plating is located at 2140 Acoma Street in Sacramento, California. For the purposes of this testing program, only the decorative chrome plating tank will be tested. The 42-inch wide, by 36-inch deep, by 94-inch long chrome plating tank has no add-on tank ventilation. Emissions are controlled using a fume suppressant added to the plating solution.

III. SAMPLING LOCATIONS AND METHODS

A. PLATING TANK SOURCE TESTS

This source test will be performed by constructing a capture hood with plastic sides and top and a 12-inch exhaust duct centered above the decorative chrome plating tank, Figure III-1. Exposed surfaces of the hood and duct assembly will be made of plastic sheeting and PVC flex hose and tubing. The sampling console will set at ground level with samples drawn from two perpendicular ports placed in a single cross sectional plane in the fabricated duct leading from the test tank to an opened area directly behind the plating tank. A fan with a controller will be located downstream of the sampling location to generate the necessary stack flow. Exhaust from the test system will be vented inside the enclosed facility approximately twenty feet behind the plating tank.

Figure III-1
Capture Hood



The average face velocity between the tank and the capture hood will be equal to or less than 50 feet/minute. The capture hood and duct assembly air flow will be maintained between 900 - 1300 cubic feet per minute. The air flow will be monitored at the console and measured at the sample port test points. The 50 feet/minute face velocity standard was established by the American Conference of Government Industrial Hygienist for effective air conditioning systems. Also, 900 cfm keeps the air from escaping out from under the hood perimeter and is within the operational range of the sampling equipment.

Duct flows at the sampling location will be determined by ARB Methods 1 through 4. Method 1 determines the velocity and sampling traverses. Method 2 determines stack gas velocity with a pitot tube and is used to calculate volumetric flow. Method 3 determines dry molecular weight. Method 4 is used to determine stack gas moisture content. These methods also require the measurement and recording of stack temperature, ambient temperature, and barometric pressure during sampling.

ARB Revised Draft Method 425 – Determination of Total Chromium and Hexavalent Chromium Emissions from Stationary Sources will be used to determine the chromium emissions from the vent stack. This method collects a sample isokinetically into 3 impingers. The first two impingers are charged with 100 milliliters each of 0.1 normal sodium bicarbonate solution. The third impinger is dry. Also, this method will separate each collected sample part into two portions. One portion is analyzed for total chromium and the second is analyzed for hexavalent chromium.

ARB's Northern Laboratory Branch will perform the laboratory analysis for total and hexavalent chromium. Hexavalent Chromium analysis will be in accordance with Standard Operating Procedure (SOP) MLD039, Standard Operating Procedure for the Analysis of Hexavalent Chromium at Ambient Atmospheric Levels by Ion Chromatography. Total Chromium analysis will be performed in accordance with SOP MLD061 Standard Operating Procedure for the Trace Elemental Analysis of Low-Volume Samples Using Inductively Coupled Plasma – Mass Spectrometry.

The sample runs will be conducted at Sherm's with one sample run conducted per day.

B. INDOOR MONITORING

Six indoor samples will be collected with a BGI PQ-100 ambient sampler at Sherm's Custom Plating. One ambient sample will be collected during each of the three isokinetic sample runs. The ambient sampler will run four to eight hours per day while stack testing is being conducted. Three additional ambient samples will be collected on three successive days following the isokinetic sample runs to establish a qualitative indoor baseline for hexavalent chromium concentration.

Ambient samples will be collected using a filter treated with sodium bicarbonate and be analyzed for hexavalent chromium only. The BGI PQ-100 sampler will be set up near the decorative chrome plating tank.

C. ADDITIONAL PARAMETERS TO BE MEASURED

During the source test period, the parameters listed in Table III-2 will be monitored and the information recorded at the specified frequency. Table III-2 also indicates the person(s) responsible for collecting this information.

Table III-2
Plating Tank Parameters to be Monitored during Source Sampling

Parameter	Measured by	Frequency
Plating tank length, width & depth.	SSD Staff	Before sampling.
Smoke test of capture hood and ventilation system.	SSD Staff	Before sampling and when sample team measures change in exhaust velocity.
Tank freeboard (solution surface to tank top/vent bottom)	Operator & SSD staff*	Daily and as necessary
Chromic solution surface tension	Operator & SSD staff*	Daily and as necessary
Concentration of chromic acid	Operator & SSD staff*	Daily and as necessary
Plating solution temperature, amps, volts, and amp-hours	Operator & SSD staff*	Every ½ hour and/or as parts change as directed by SSD Staff.
Any additions to the bath.	Operator & SSD staff*	If any during the source test.
Type of fume suppressant used.	Operator & SSD Staff*	Once during testing
Type, number, description of parts.	Operator & SSD staff*	As parts change (at least once per stack sample run).
Record when the calibration of ampere meter was performed then compare the ampere-hour meter against the ampere meter	SSD Staff	Once during testing
Record thickness and presence of foam on the tank	SSD Staff	Daily and as necessary
Record distance between the plating solution and the hood	SSD Staff	Daily and as necessary

*Sample collected and/or parameter measured by appropriate facility personnel (Operator) with SSD staff directing, observing, and recording.

IV. SAMPLING PLAN

The source test team will arrive at the test site on Monday morning to setup and perform preliminary stack determinations. The plating facility has no ventilation system for the tank; therefore, setup will include the installation of a hood, duct, and fan system (See Figure III-1 for the hood assembly).

Once setup is complete, stack sample collection and ambient indoor monitoring will begin on Tuesday. Sampling will continue on Wednesday and Thursday with the collection of one ambient indoor sample and one stack emission sample “run” per day. Method 425 sample trains will be recovered at the end of each day. The samples will be stored on ice and transported to the lab. Ambient filters will be kept dry and transported to the laboratory with the emission samples.

Samples will be collected during normal tank operations if possible. Normal plating tank loads will be supplemented with "dummy" parts to extend the sampling time. When dummy parts are used, the plating current will be turned off and on as deemed appropriate and feasible by SSD staff and by the facility operator.

The analytical detection limit for chromium using SOP MLD061 is about 1 nanogram per milliliter (ng/ml) of sample solution or about 1.54×10^{-8} grains per milliliter (grains/ml). Target concentration per analytical sample is about 10 times that amount for quantification of samples collected by ARB Method 425 sample trains. A Method 425 hexavalent chromium sample train will generate 3 different samples for analysis; 1) probe and transfer line rinses, 2) first impinger contents, and 3) second and third impinger contents. This means the desired target amount for the entire sampling train is about 30 times (10 x 3) the analytical detection limit, or about 4.6×10^{-7} grains/ml.

The total amount of chromium sample collection solution for each train is about 300 milliliters. There will be a little more than 100 milliliters (ml) of sample collection solution (0.1N sodium bicarbonate) for each of the two impinger samples and about 100 ml more for the probe and transfer line rinses. Therefore, the desired target mass of hexavalent chromium for each sample train is about 1.4×10^{-4} grains (300 ml at 4.6×10^{-7} grains/ml).

US EPA chromium emissions estimates (from AP-42 emission factors) for decorative chromium plating tanks with suppressants are 1.2×10^{-6} grains of chromium compounds per dry standard cubic foot (grains/dscf). The emission factor for decorative tanks assumes 99.6 percent control efficiency for fume suppressants and almost all of the chromium emissions are hexavalent chromium. At the US EPA emission rate, about 120 dscf will have to be collected to reach the target mass for analysis (1.4×10^{-4} grains divided by 1.2×10^{-6} grains/dscf). At a sample collection rate of about 0.65 dry standard cubic foot per minute (based on hexavalent sampling by ARB at hard chromium electroplating facilities with plating tank ventilation systems), total sampling time per sample train calculates to a little over 3 hours. To ensure that detectable amounts of hexavalent chromium are collected during testing, sample collection times will be approximately 4 to 6 hours per sample run.

V. QUALITY ASSURANCE

A detailed explanation of the ARB's standard field and laboratory quality assurance procedures are contained in ARB Quality Assurance manuals, Stationary Source Test Methods, and laboratory SOPs.

A. HOOD ASSEMBLY AND DUCTING

Following the source test at Sherm's Custom Plating, the hood assembly and ducting will be source tested (i.e. post-tested) at MLD's warehouse, per methods outlined in section III, to determine if any equipment contamination occurred during the Sherm's Custom Plating source test. Note, results from previous warehouse source testing of the hood assembly and ducting will be used to establish the qualitative pre-test baseline information.

B. PRE-TEST CLEANING/CONDITIONING

As required by Method 425, all surfaces that come in contact with a chromium sample are made of either Teflon™ or glass. Per Method 425, these surfaces will be pre-washed with detergent, soaked with a 10% solution of nitric acid for several hours and flushed with water. This includes sample collection equipment and storage containers. Following cleaning, all components are rinsed with a 0.1 N sodium bicarbonate solution and the resulting rinse is submitted to the lab for hexavalent chromium analysis and recleaned and analyzed if necessary. One extra, complete sample train, of pre-cleaned equipment will be deployed to the sampling site to ensure that no equipment needs to be re-cleaned or re-used during field sampling.

Six trains require cleaning, analysis, and assembly. They will be used as follows:

3 trains for sample runs
1 blank train
1 train for warehouse post test
1 spare train

Forty-eight 500 ml sample jars require cleaning and analysis. They will be used as follows:

9 sample jars for three sample runs (probe line and impingers)
3 sample jars for the blank train (probe line and impingers)
3 sample jars for the post-test (probe line and impingers)
1 sample jar for nozzle washing analysis
3 sample jars for probe washing analysis
1 sample jar for probe line washing analysis (6 lines)
6 sample jars for train glassware washing analysis
2 sample jars for sample jar analysis
3 sample jars for ancillary glassware
1 sample jar for weekly collection/recovery solution analysis

16 spare jars

C. SAMPLING EQUIPMENT CHECKS

Sampling consoles used during the source test will be calibrated before and after deployment for sample collection. Type S pitot tubes on sample probe assemblies and used for stack velocity determinations meet the required specifications for a baseline coefficient of 0.84 as specified in ARB Method 2.

Each pitot tube assembly, including manometers and transfer lines, will be leak checked before and after each velocity determination. All sample train assemblies, including consoles, transfer lines, and sample collection equipment will be leak checked before and after each sampling run.

D. BLANKS AND SPIKES

Prior to deployment, the laboratory will analyze each collection and recovery solution prepared for the test team. The analysis results are used by the laboratory to correct the analytical results of the test team's collected samples.

A solvent trip blank of the collection and recovery solution will be collected at the conclusion of site-sampling, transported to the analytical lab, and analyzed with the collected daily sample. Trip blank analytical results less than or equal to 10% of the collected sample concentration shall be considered acceptable.

A blank train will be prepared similar to a sampling train. The blank train will parallel a selected sample train from setup to recovery, except no sample will be collected by the blank train.

No spikes are planned.

E. SAMPLE COLLECTION AND STORAGE

All stack test samples will be collected using an iced impinger set and remain on ice until recovery to maintain their temperature at or below 4 °C (39 °F) as required by Method 425. Sample recovery will be the same day as sample collection. After recovery, samples will be stored on ice to maintain their temperature at or below 4 °C (39 °F). Collected and recovered Method 425 samples will remain on ice while on site and during transport to the laboratory for analyses. Staff at the laboratory will check that the samples arrived at or below 4 °C (39 °F) and will maintain this temperature until analysis.

During sample collection and transport, the pH of the solution used for the probe rinse and impinger charging will be maintained at ≥ 8.0 as required by Method 425. This is necessary to ensure that any collected hexavalent chromium is not reduced to trivalent chromium. The pH of the impinger solutions will be checked before and sampling. The pH of nozzle, probe and transfer line will also be checked before and after sample recovery.

Ambient sample filters will be collected and stored in a cool, dry, dark place. This will be accomplished by removing the filter with clean gloves, returning the filter to it's plastic case, and storing the samples in a ziploc bag in a dry location until delivered to the laboratory.

F. SAMPLE LABELING

Each sample train will be labeled indicating the facility being sampled, the sample run number, sampling data and other appropriate information. During recovery, each sample portion from the same sample train will also be labeled with the appropriate sample run and identification number. This sample run and identification number will be used during transport, transfer to the laboratory, and laboratory analysis to identify each sample or sample portion.

Each sample container will be labeled on the side and top, and the sample level indicated with a line marked on the side of the container.

The following sample identification and labeling conventions will be used for this project:

```
Sample Numbering:  S 1 - P
                   | |   |→P=Probe and nozzle rinses
                   | |      1=1st Impinger catch
                   | |      2=2nd and 3rd Impingers
                   | |-----------→Run Number
                   |                  1= 1st Sample Run
                   |                  2= 2nd Sample Run
                   |                  3= 3rd Sample Run
                   |                  B= Blank Sample
                   |-------------→Facility Designator (Sherm's Custom Plating)
```


The ambient filter for each test run will be annotated as follows:

```
Sample Numbering:  S 1 - A
                   | |   |→A=Ambient Filter
                   | |
                   | |-----------→Run Number
                   |                  1=1st run
                   |                  2=2nd run
                   |                  3=3rd run
                   |                  4=1st baseline run
                   |                  5=2nd baseline run
                   |                  6=3rd baseline run
                   |
                   |-------------→Facility Designator (Sherm's Custom Plating)
```

G. CHAIN OF CUSTODY

A chain of custody sheet will be prepared for each ambient filter and sample train during recovery. Each chain of custody will list all the samples recovered from the train including each sample identification number and chain of custody log number. The source test leader will update and keep a chain of custody log.

From the time the sample is collected, each change in sample custody will be noted and signed on the sheet. The chain of custody sheets will travel in the cooler with the train samples until the samples are transferred to the laboratory. At that point, the chain-of-custody sheets are signed by the laboratory sample receiver, returned to the test leader, and the laboratory initiates its own internal chain of custody.

VI. SAFETY

All electroplating facilities require safety glasses around the plating tanks. A few require respirators in specific locations. Most plating facility employees also use chemical resistant outer clothing and gloves when working around plating tanks.

A. PERSONAL PROTECTIVE EQUIPMENT

Safety Glasses/Goggles – **Required**
Long sleeves/pants - **Required**
Respirators (w/ HEPA) – Suggested
Hearing Protection – Ear plugs or "Mickey Mouse" ears recommended around fans.
Hard Hats – During setup, tear down, and as needed.
Steel-toed shoes – During setup, testing, and tear down.
Liquid-resistant Shoes – Many facilities may have hazardous liquids like chromic acid collected on the floor or ground.
NOMEX Coveralls – Suggested for electrical arc protection. (For working around plating tank. Amperage loads are in hundreds or thousands of amps.)
Gloves – NDEX/latex (chemical protection) and leather (abrasion protection).

B. ADDITIONAL SAFETY EQUIPMENT

Safety Cones - ~6 for M5 van and overhead work area.
Barrier Tape - w/ "Caution "

VII. PERSONNEL AND VEHICLES

A. MLD AND SSD EMISSIONS TEST TEAM

The MLD and SSD sampling team will consist of one console operator, two to three instrument technicians, and one SSD representative.

Project Lead/SSD Representative:	Shobna Sahni
Lead Test Engineer:	David Todd
Console Operator:	Don Ridgley
Lead Setup and Recovery Technician:	Ron Barros
Stack Technician:	Don Ridgley

B. TEST VEHICLES

1. M-5 Sampling Van (driven by Ron Barros).
2. Bi-fuel Pickup (driven by the MLD and SSD Sampling Team).

VIII. CONTACT PEOPLE

A. ARB

Monitoring & Laboratory Sampling Lead:	David Todd, (916) 322 - 8915
Stationary Source Division Project Lead:	Shobna Sahni, (626) 575-7039

B. SHERM'S CUSTOM PLATING:

Position: General Manager	Art Holman, (916) 456-5600